SELECTED NUTRITIONAL AND CHEMICAL CHARACTERISTICS OF UNCOOKED AND COOKED VARIETY MEATS

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Background

In the United States (U.S.), variety meats traditionally have been used as ingredients in sausages and other processed meats to contribute binding, color, water holding capacity and nutritional value. Yet, consumers in the United States are reluctant to purchase foods wherein variety meats are labeled. Although commonly used in other countries, consumers in the U.S. often reject products containing meats such as heart, jowls, snouts, spleen, tongue, and tripe. Consumer knowledge of the composition of variety meats, and an understanding of the nutritional value of such products may allow a more effective utilization of variety meats in the U.S. This project was initiated to provide compositional and nutritional information on variety meats.

Objective

Research at Clemson University was conducted on raw and cooked variety meats from beef and pork to determine selected nutritional and chemical characteristics in order to more effectively utilize those meats in the United States.

Experimental methods

Variety meats were obtained from ten commercial meat-processing facilities and two University abattoirs. Experimental material included cheek, diaphragm, heart, jowls, lymph nodes, neck (bones, meat and trimmings), shanks, shoulders, snouts, spleen, stomach, tongue and tripe. Samples were obtained, when available, both from beef and from pork. All meats were received frozen from commercial sources or frozen immediately after acquisition from University abattoirs. Samples then were stored at -20°C until analyzed. When required for analysis, meats were placed in refrigerated storage at 4°C until thawed. Raw (uncooked) meats subsequently were ground twice through a grinder, utilizing a 2-3 mm diameter orifice end plate. Half of the ground samples were placed in freeze-drying flasks, and then lyophilized. The remaining half of ground samples were placed in cooking barrier bags, and then cooked. Cooking was accomplished by immersing barrier bags in a circulating water bath preheated to 90° C until internal temperature of the sample was 70°- 72° C. Bags then were immersed in cold water until meats attained ambient temperature. Cooked meats were separated from cooked-out material, then ground and lyophilized as above.

Lipid and protein content was determined on uncooked and cooked lyophilized meats. Crude lipid content was determined by the Soxhlet method (AOAC, 1990). Protein analysis was conducted using macro-Kjeldahl (AOAC, 1965). Protein content was calculated using 6.25 as conversion factor.

Total amino acids in meats were determined as described by De Groot and Slump (1969). Amino acids were detected using a Dionex 2000i ion chromatographic system equipped with ninhydrin detection capabilities (Benson, 1976). Sulfur amino acids (cystine and methionine) were determined by a pre-treatment of samples with performic acid for 16 hours (Moore, 1963).

Digestibility was determined by an *in vitro* pH-shift method as described by Satterlee et al. (1982). Lyophilized samples were ground, then weighed such that an equal amount of protein was used for analysis. Weighed samples were placed in small vials; the vials were covered with parafilm, and then stored at –20°C until used. For analysis, samples were rehydrated with deionized distilled water then stored at 4°C for 12 hours prior to in vitro digestibility determination. Four enzymes, protease (Sigma P-5130), chymotrypsin (Sigma C-4129), peptidase (Sigma P-7625) and trypsin (Sigma T-0134), were used for protein digestion. Results were obtained by determination of pH change over time. Sample pH was recorded at 20 min., and then used to calculate digestibility compared with that of casein (sodium caseinate). Calculated protein efficiency ratio (C-PER) then was derived from amino acid and digestibility data using the equation described by Satterlee et al. (1982).

Results and discussion

Comparisons of digestibility determinations for variety meats are shown in Table 1. Digestibility values ranged from a low of 76.32 for cooked beef spleen, to a high of 85.95 for uncooked lymph nodes/tongue fat. These values compare to *in vitro* digestibilities of 89.57 to 94.16 in studies of feed grade egg product, a by-product of the egg industry (Phimphilai, 2002) and to *in vitro* digestibilities of 94.79 for the casein reference protein. As may be expected of variety meats, the *in vitro* study of digestibility indicates that these products may present a more difficult material than other by-products from which nutrients can be utilized for nutritional purposes.

Table 1 also shows C-PER values for the experiment. C-PER ranged from a low of 1.43 for uncooked pork spleen, to a high of 2.75 for uncooked pork neck trimmings. These results compare to C-PER values from 2.59 to 2.62 in studies of feed grade egg product (Phimphilai, 2002) and to C-PER values of 2.50 for the casein reference protein. As with digestibility data, the C-PER of variety meats, with some exceptions, is lower than C-PER from egg by-products and C-PER from casein. Exceptions such as heart, neck trimmings and shoulder are very comparable to casein in C-PER values. The practical effect of these differences in C-PER is not known; however, these data may allow more information in the usual careful consideration of nutritional characteristics of variety meats used in foods destined to human or animal consumption.

Since calculation of C-PER requires determination of amino acids in experimental material, proline and hydroxyproline values were available within this study. Further, since proline and hydroxyproline are higher in connective tissue than in other tissues, a comparison of those amino acids in this study was considered appropriate. Amino acid contents of proline and hydroxyproline in variety meats are shown in Table 2. Proline values ranged from a low of 1.12 g/100g for cooked lymph nodes/tongue fat, to a high of 6.05 g/100g for uncooked neck meat. These values compare to 1.70 g/100g to 2.17 g/100g proline in studies of feed grade egg product (Phimphilai, 2002) and to 2.55 g/100 for dried whole milk (USDA, 2001). Hydroxyproline values ranged from a low of 0.18 g/100g for heart, to a high of 5.71 g/100g for uncooked tripe. Amino acids associated with connective tissue in variety meats may be an important consideration in the functional properties of those meat products. In this study, proline content appeared lower in cooked product when compared to the uncooked product, which may be related to heat solubilization and subsequent cook-out of connective tissue. Further studies will allow a statistical evaluation of those observations.

Pertinent literature

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Table 1. Digestibility and calculated protein efficiency ratios (C-PER) of uncooked and cooked variety meats from beef and pork.

Meat type	Digestibility (%)				C-PER			
	Beef		Pork		Beef		Pork	
	Uncooked	Cooked	Uncooked	Cooked	Uncooked	Cooked	Uncooked	Cooked
Cheek	81.01	82.50	-	-	2.19	2.37	-	-
Diaphragm	81.60	80.70	84.48	83.24	2.38	2.40	2.50	2.50
Heart	82.34	81.23	85.10	81.15	2.48	2.46	2.60	2.46
Jowls	-	-	85.48	81.96	-	-	2.24	2.07
Lymph nodes/Tongue Fat	85.95	81.66	-	-	1.44	2.04	-	-
Neck Bone	-	-	-	79.63	-	-	-	2.29
Neck Meat	82.67	81.04	-	-	2.18	2.24	-	-
Neck Trimmings	81.66	83.91	88.65	-	2.29	2.21	2.75	-
Shanks	84.81	81.09	-	-	2.21	2.05	-	-
Shoulder	-	-	85.80	81.66	-	-	2.44	2.38
Snouts	-	-	84.20	81.71	-	-	1.43	1.48
Spleen	83.57	76.32	80.42	76.58	2.33	2.16	2.28	2.17
Stomach	-	-	87.18	83.64	-	-	2.05	1.82
Tongue	80.22	82.26	-	-	2.11	2.34	-	-
Tripe	85.12	83.35	-	-	1.94	2.22	-	-

Table 2. Proline and Hydroxyproline in uncooked and cooked variety meats from beef and pork.

Meat type	Proline (g/100g)				Hydroxyproline (g/100g)			
	Beef		Pork		Beef		Pork	
	Uncooked	Cooked	Uncooked	Cooked	Uncooked	Cooked	Uncooked	Cooked
Cheek	3.42	2.79	-	-	1.22	0.85	-	-
Diaphragm	2.96	2.66	-	-	0.95	0.76	-	-
Heart	3.62	2.75	3.54	2.44	0.18	0.33	0.70	0.59
Jowls	-	-	4.07	0.86	-	-	1.78	1.04
Lymph nodes/Tongue Fat	1.94	1.12	-	-	2.01	0.70	-	-
Neck Bone	-	-	-	1.77	-	-	-	0.76
Neck Meat	6.05	3.30	-	-	2.61	1.37	-	-
Neck Trimmings	4.14	2.81	2.15	-	1.29	2.90	0.56	-
Shanks	3.85	3.72	-	-	2.64	2.44	-	-
Shoulder	-	-	2.34	1.28	-	-	0.79	1.12
Snouts	-	-	3.22	2.96	-	-	3.02	3.15
Spleen	5.16	2.60	3.20	0.73	0.94	2.16	1.03	0.41
Stomach	-	-	4.14	4.25	-	-	3.56	2.93
Tongue	2.42	1.65	-	-	1.06	1.68	-	-
Tripe	5.63	3.94	-	-	5.71	1.71	-	-